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Articles		PAGE
Some Results of Astronomical Work during 1919 (Retiring President's Address)	A. F. Miller	41
The Festival of the Dead (Continued)	R. G. Haliburton	59
Meetings of the Society		
Annual Meeting		70
Notes from the Meteorological Service		
Temperature, Precipitation, Earthquake and Magnetic Disturbances		78
Astronomical Notes		
Theory of Gravitation	J. R. C.	83
Notes and Queries		
Query, Recollections of R. G. Haliburton,		
The State of the Society, A bright meteor	C. A. C	84

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SOME RESULTS OF ASTRONOMICAL WORK DURING 1919

BY A. F. MILLER

(*Retiring President's Address, January* 26, 1920)

THIS evening it is alike my duty and my privilege to address you as retiring President of the Royal Astronomical Society of Canada, and after consideration I have taken for my subject, *Some Results of Astronomical Work during 1919*. Astronomy has become such a vast and complex science, reaching out towards, and resting upon other sciences, with which not very long ago it seemed to be quite unconnected, that I felt, and feel, it might have been wiser to confine my remarks to a single department of the subject. However, I could not justify to myself the adoption of that course unless prepared to speak, to some extent at least, of work with which I have had experience, preferably of some line of research in which I had at least taken a part. Unfortunately, subject to that restriction, nothing was possible to me; therefore I concluded to follow the course generally adopted in addresses of this kind delivered before the Society, and speak, so far as the time at my disposal will permit, on astronomical matters of greatest

general interest, most deserving of your attention, and suited to bring before those not in close touch with recent progress some information of happenings in our own immediate environment, the solar system, and, at least an outline of the new knowledge gained during the past year relative to that vast universe of stars and nebulae, compared with which our sun, and its family of planetary worlds, form but a minute unimportant point.

But first I turn for a moment to review the conditions under which astronomers were obliged to carry on their work during 1919. The world-war was indeed happily brought to a conclusion ere the year began, but the awful and titanic struggle left social wounds which centuries will scarcely obliterate, bringing also into existence conditions which still react adversely upon the whole civilized world, and will continue indefinitely to affect future generations. For the strife of nations has ceased, only to be succeeded by the strife of classes, by world-wide unrest and discontent, and by a development of individual selfishness heretofore unparalleled. Now, of all men, he who is restless, discontented, self-centred, is least inclined to look abroad and find pleasure in the study of nature, or to aid in the advancement of science, unless indeed science can be commercialized and utilized as a means of gain, in which respect astronomy neither claims, nor seeks, to stand in the front rank, and therefore is relegated to the background. These depressing conditions were obviously most effective in the countries nearest to the scenes of actual hostilities. News received from many European observatories tells of stress and hardship, the effects of the war making themselves painfully felt after its actual conclusion. Astronomers and other workers were wanting; some dead on the field of battle, others incapacitated by wounds or health impaired through the strenuous conditions of military service; still others detained to discharge duties different to those for which their special training had been designed to qualify them. Observatories near the actual seat of war, in which the large instruments had been practically dismantled for security's sake could not speedily resume work with full efficiency. The state of affairs in Russia renders at least dubious the condition of the world-famed astronomical centres located there. In curious contrast we notice that the directorates of some German observatories have declared, with

characteristic boastfulness and self-complacency, that not merely have they gone on uninterruptedly and efficiently with their work but that their equipments have acquired important instrumental additions. In which connection it is enlightening to recall a letter addressed to a prominent English scientific journal[1] by Professor R. Jonckheere, director of the Observatory of Lille, the only first-class French observatory (fortunately), which fell under the power of the Hun marauder. Returning from his exile in England, he relates to his confrères a heart-breaking story of the utter devastation and ruin wrought during the German occupation of the place. All the smaller instruments stolen, along with such parts of the larger as could by any possibility be made use of by the captors; and what they could not carry off, ruthlessly and systematically destroyed, or ruined beyond repair: The axes of the equatorial bent or broken; the circle graduations defaced and obliterated with a sharp-pointed tool; the dome wrenched out of circularity so as to be incapable of turning; all the clocks purloined, save one, and that one ruined by a corrosive fluid poured into the movement. The whole work of robbery and destruction carried out with such minute and systematic ingenuity of devilish spite as to demonstrate only too clearly that it had been perpetrated by persons perfectly familiar with astronomical and scientific instruments. Other instances of like character might be readily cited, but let the one suffice. Can we then wonder that scientists of the allied nations, honourable and kindly men as they are, feel repugnance when the suggestion is made that fraternal relations in matters of science be resumed with the perpetrators of such abominable and contemptible acts? A few, indeed, seem inclined to condone the offences committed *against others*, but happily, those so minded are greatly in the minority. Permit me to quote a few words uttered, not by a Frenchman, naturally embittered by the misery and loss brought upon his native land; not even by an Englishman, who had begun to realize what the savageries of the Hun have entailed upon his nation and empire. The speaker is an American, distinguished for scientific attainment and for qualities of mind and character which place him in the foremost rank among men. Speaking with reference to the establishment of the

[1] *The Observatory*, July 1919.

International Astronomical Union, Professor W. W. Campbell[1] thus expresses his views:

"The scientists of the allied and associated nations were of opinion that personal relationship with the scientists of the central nations should not be renewed; at least until the offending governments and peoples shall have renounced their past, and apparently present, political methods."

I acknowledge that in referring to these maters I have digressed from my proper subject. However, I feel it incumbent on me as I retire from the presidency to point out to the Council and membership of the Royal Astronomical Society of Canada the impropriety, the unwisdom, of friendly intercourse on any ground with men such as the scientists of Germany have shown themselves to be. An old Greek poet long ago related, that, disgusted with the injustice, misrule, and vices of the Olympian deities, the brave, wise, loving, much-enduring titan Prometheus adopted as a guiding principle this rule: "Accept no gifts from the gods". With a slight, but significant alteration, we would do well to adopt it as ours: "Accept no gifts from—*the other parties*"

Though the last maximum of solar activity undoubtedly occurred towards the latter part of 1917, sun-spots continued to appear very frequently during the past year, there being relatively few days on which the solar disc was entirely spotless, and on several occasions the spots or spot-groups were of such large dimensions as to be visible to the unaided eye. This continuance of solar activity was often mentioned at the Society's meetings. Naturally such a very large amount of observational study and research in connection with solar physics has been accomplished during 1919, that it would be impossible for me to give even the briefest outline of all the results, I will therefore mention only one very important and deeply interesting investigation conducted under the direction of Prof. G. E. Hale, at the Mount Wilson Solar Observatory.[2] It will be necessary at the outset to remind you that, as far back as 1908, plates secured at that observatory by the photo-heliographic method demonstrated conclusively that sun-spots have a vortical structure. In hundreds of instances masses of hydrogen were

[1] *Publications, Astronomical Society of the Pacific*, Oct. 1919. p. 250.
[2] *Mount Wilson Solar Obs.*, No. 165.

shown in the act of being drawn towards the centre of spots as though sucked into a vortex. The photographs suggested the hypothesis that a sun-spot is a vortex in which electrified particles, resulting from ionization in the solar atmosphere, are whirled at high velocities. Search for the Zeeman effect resulted in its immediate discovery, along with abundant proof of the existence of a magnetic field in every sun spot observed. Subsequent investigation led to the view that two classes of vortices are involved: High-level vortices centering in sun-spots, revealed when monochromatic images of the sun are photographed with the light of the central part of the H_a line In these the motion of the hydrogen appears to be spirally inward and downward: Low-level electric vortices formed in the photosphere. These constitute the sun-spots themselves, and in them the motion of the gases appears to be spirally upward from within the photosphere, and outward along its surface. The magnetic classification of sun-spots based upon determination of their magnetic polarities seems to point to a division into three classes. Unipolar spots are single spots, or groups of small spots, having the same magnetic polarity: Bipolar spots, which in their simplest characteristic form consist of two spots of opposite polarity: Multipolar spots, which contain spots of both polarities so irregularly distributed as to prevent classification as bipolar groups. This class comprises only about one per cent. of the total spots observed.

The magnetic polarity of sun-spots was determined by observations of their spectra under very high dispersion, the components of a Zeeman "triplet" being studied by means of a Nicol polarizing prism, which shows different relative intensities in the π components. It is further pointed out that the lines of force in sun-spots can be measured with considerable precision. About 60 per cent. of the groups observed are binary groups, the members of which are of opposite magnetic polarities. It must be noticed as a remarkable fact that before the last sun-spot minimum, the magnetic polarity of unipolar spots, and the preceding members of bipolar spots, was positive in the southern, and negative in the northern, hemispheres of the sun. But immediately after, and since, the minimum, (which occurred in 1912), these signs have been reversed. It may reasonably be hoped that the results just summed up will greatly aid

in the discovery of the cause of sun-spots, periodicity, as well as terrestrial magnetism, undoubtedly connected therewith. I might further call attention to the curious fact that frequently dark masses have appeared in the Mount Wilson photographs of the solar disc, which on their arrival at the limb recorded themselves as true solar prominences. Before terminating this notice of work done at Mount Wilson I may just remind you that the great reflecting telescope of 100 inches aperture, the largest telescope ever constructed, was successfully put in operation there in 1919.

In connection with solar physics I would much like to speak of several investigations relative to the spectrum; however time forbids me to say more than a few words. Within recent years the improvements in laboratory methods and apparatus have been turned to such good account that at the present time relatively but few of the many thousands of lines in the solar spectrum remain unidentified with the spectral lines of metals or other terrestrial substances. It is not a little curious to learn that quite recently a number of fine narrow bands in the ultra-violet region, previously of unknown origin, have been found identical with bands in the spectrum of ammonia when that gas is injected into an electric arc formed between copper poles. Some time ago, as you may remember, bands due to water vapour were found to exist in the sun's atmosphere.

At this point I think reference should be made to the total solar eclipse of May 29, 1919, on which date the cone of the lunar shadow traversed broad regions of the South American and African continents. This eclipse is of particular interest because of observations undertaken, and successfully carried out, to test the correctness of one, probably the most important, of three predictions made by Albert Einstein, a Swiss physicist residing in Prague, in connection with what is termed his "relativity hypothesis". Einstein evolved his theory through mathematical reasoning of so abstruse a character as to be quite beyond the possibility of a popular exposition; in fact very able mathematicians fully admit their inability to follow his reasoning and formulae to the ultimate conclusion. However, as the outcome of his research, Einstein felt justified in stating that his hypotheses fully accounts for the anomalous shifting of the major axis of the orbit of Mercury, for which the previously

accepted, though not entirely satisfactory, explanations demanded the existence of an inter-Mercurial planet, never detected, or the presence of ponderable matter in the vicinity of the sun, a theory rendered improbable by the near perihelion passages of many comets. Einstein further showed that light from stars passing through a powerful gravitational field must suffer deflection towards the body producing the field, to an extent which should be measurable, the quantity of which deflection he computed as 1.75 seconds of arc for a star (apparently) at the sun's limb. A third conclusion from the hypothesis was, that a slight shift towards the red should be found to prevail in the lines of the solar spectrum. The completeness with which the relativity hypothesis explains the shifting of Mercury's perihelion point, aroused general and deep interest among astronomers, particularly on the part of those specially occupied with the theory of gravity, for which they demand, and can only rest satisfied with, absolute accuracy. Therefore a very general desire was felt to test the hypothesis by actual observations, which could only be made during a total solar eclipse, since then only would it be possible to photograph stars in very close proximity to the sun's apparent place in the sky. Attempts were made on the occasion of the eclipse of June 8, 1918, to achieve this result, but proved unsuccessful. Consequently it was decided by the British Eclipse Association to renew the effort during the eclipse of May 29, 1919, which offered the special advantages of an unusually long totality at a time when the sun would be projected on a background of the sky occupied by the bright group of the Hyades and the brilliant star Aldebaran. Accordingly two expeditions or observing parties were dispatched, each having two highly competent trained observers, to secure the desired observational results in the form of photographs of the eclipsed sun together with the stars near its place during the period of totality. One of the parties consisting of Dr Crommelin of Greenwich Observatory and Mr. Davidson, was dispatched to Sobral in northern Brazil. The other, comprising Prof. Eddington of the University of Cambridge, and Mr. Cottingham, went to the island of Principe on the west coast of Africa. The state of the sky at the first-named station during totality was all that could be desired, and several satisfactory plates were secured. At Principe,

unfortunately clouds interfered to some extent; in spite of which, however, five star-places were recorded. The observers at Sobral remained long enough after the eclipse to secure the requisite comparison on check plates, when the sun's ecliptic motion had made possible photography of the same star-field before sunrise. For the Principe plates another method of comparison was employed. Recently, when giving an account of the results achieved, Sir Frank Dyson, the Astronomer Royal, felt justified in stating that unquestionably the light from the stars photographed near the sun deviated, and did not come as directly in a straight line as it would had the sun with its powerful gravitational field not been there; that it was certainly deflected towards the sun, and as a matter of fact the amount of this deflection was practically in complete agreement with Einstein's prediction based on his relativity hypothesis. This remarkable verification of a prediction derived from a transcendental mathematical theory, is of the highest interest to astronomers the world over, and possibly may lead to important conclusions as to the cause of gravity and the nature of the medium through which it acts. I should add here that Einstein's third corollary as to the shifting of the solar spectrum toward the red, has not been verified, though looked for by Dr. St. John with the powerful appliances available for the purpose at Mount Wilson. However, the anticipated shift is very small, and its detection demands accurate allowance for other causes of displacement, by which the problem is affected and made more complex than might appear at first sight; therefore we may hope verification will be forthcoming later. Einstein himself would regard his hypothesis as untenable should his conclusion on this last point be disproved.

At the same eclipse other observations on the usual and more general lines of photography and spectroscopy were of course not neglected. The great brilliance of the corona was a marked feature; and a prominence remarkable for its vast size was observed visually and recorded photographically. Although not so fantastic an object as "The Heliosaurus" which astonished the observers of the 1918 total eclipse, the enormous hydrogen mass visible to those who had the good fortune to be within the shadow-path on May 29 last, far exceeded the other in actual dimensions and in brightness. And a further interesting fact is, that it had existed as a hydrogen

cloud on the sun's surface for a month prior to the eclipse, fortunately reaching the limb at the critical time. It seems to have been the only noticeable prominence form in evidence on that occasion.

I must not detain you with any detailed description of interesting experiments conducted, relative to the transmission of wireless signals through the shadow-cone between stations outside the line of totality. Our members, and probably others present, had the opportunity of hearing an interesting lecture by Prof. Bauer of the Carnegie Institute, who went to Liberia to observe the variation of terrestrial magnetism and atmospheric electricity during the total phase.

A very regrettable circumstance is, that French astronomers, even those engaged at Paris and Meudon, were prevented, because of financial stringency, from going abroad to make observations of the eclipse on May 29. It was then just one year more than half a century since Jansen made his ever-memorable discovery of the gaseous nature of the chromosphere and prominences. Two years later, to continue his investigations on the phenomena of another total eclipse, he was obliged to escape from beleagured Paris by means of a balloon.

There are a few matters relating to the sun's family of planetary worlds, to which I ought to make some reference. 1919 afforded very favourable opportunities for observation of the inner planets Mercury and Venus. The former I must pass, with only the brief reference already made in connection with Einstein's relativity hypothesis.

Regarding Venus, a good deal should be said, which I will sum up as concisely as I can. During 1919, several well-known and very competent observers drew attention to the existence, at the extremities of the crescent phase assumed by the planet when in its most favourable position, of brilliant white spots, presumably polar caps resembling those of Mars. Assuming the correctness of this opinion the axis of rotation would be practically perpendicular to the plane of the orbit, which favours the view first advanced by Schiaparelli, and since maintained by several astronomers of high standing, that the periods of the rotation and revolution of Venus are equal. It will be remembered, however, that nearly 150 years ago Schröter, after long and patient investigation, felt

justified in assigning to the planet a rotation period very similar to that of the earth, a result later confirmed by other excellent observers. Thus, although the later determination, arrived at by the aid of instruments much superior to those at the disposal of the older investigators, might be regarded as entitled to full confidence and unquestioned adoption, a strong element of doubt exists in many minds as to the propriety of accepting the later result in preference to the original one. Coincidence of the periods of rotation and revolution would seem to demand an effect of tidal retardation unauthorized by, and incompatible with, our knowledge of the planet's mass and distance from the sun, and the non-existence of a satellite; even if we place no weight whatsoever on the complete lack of analogy with the known rotation periods of other major planets. Our members will recollect that at two of the Society's meetings last autumn I invited discussion on that point, taking the grounds just mentioned. Those present had the privilege of examining a spectrogram of Venus secured at the Lowell Observatory by Prof. Slipher, who maintains that lack of inclination in the lines of the spectrum negatives the possibility of a short rotation period. However I then felt, and still believe, a period of about 24 hours would hardly involve an equatorial velocity sufficient to evidence itself by the test of inclination. Therefore I was both interested and gratified through meeting with a mathematical investigation of this subject by the Rev. Luis Rodés, S.J., director Observatorio del Ebro,[1] which to me appears to demonstrate conclusively that an axial rotation period of, say, 24 hours would be insufficient to produce a deviation from the vertical in the spectral lines distinguishable from the slight deformation due to unavoidable inaccuracy in guiding. I commend the Reverend Padre's very important paper to the careful consideration of every one interested in the study of our nearest neighbour among the major planets. It is hardly necessary to say that the axial inclination relative to the plane of the orbit need not be regarded as in any way affecting the rotation period. Did time permit I would like to refer at greater length to some very important experiments conducted at Arcadia, California, for the Smithsonian Astrophysical Observatory by Mr. L. B. Aldrich, who, by employ-

[1] *The Observatory*, August, 1919, p. 308.

ing very delicate heat-measuring instruments elevated by a military balloon above a layer of cloud and fog, has demonstrated that a planet completely enveloped in a mantle of cloud would be screened from 78 per cent. of the direct solar radiations; that quantity being radiated back into space from the surface of the cloud-screen. The fitness of planets other than our own to be the abodes of life (not necessarily intelligent), has from time to time come under discussion, the affirmative being maintained by men eminent in the world of science, though at present the subject is seldom mentioned, and sometimes with a sort of contemptuous indifference. I see no reason why it should be less deserving of consideration than some of the many recondite problems with which astronomers are occupied. Curiously enough, a statement just made by Marconi as to wireless signals of unexplained origin, which for some reason he supposes may come from Mars, has attracted popular attention to a surprising extent. Other sources for those electric waves have been suggested, as for example active solar spots. For my own part I believe they are simply results of electric disturbances in our own atmosphere; induction effects occasioned by lightning-storms occurring probably at no very great distances from wireless apparatus which happened to be tuned to respond to certain ether waves occurring as secondary results of great flashes.

Mars having been to all intents and purposes invisible during 1919, I will only remind our members that during the ensuing spring and early summer this interesting miniature of our own world will be well placed for observation, in which work, telescopes of 3-inches aperture and upwards may be turned to good account. The depicting of the Martian features on the surface of a small globe seems to be growing in favour among areographers, professional and amateur. That the Royal Astronomical Society of Canada should not be accused of lagging entirely behind the prevalent fashion, a slight effort in the line of globe construction was made in its behalf by an old member.

I spare you any reference to the Jovian planet, although the largest member of our system next after the sun.

Regarding Saturn, the remarkable albedo of the ring-system, especially Ring B, is well known to all observers. An attempt to

explain this fact has been made, on the supposition that the two outer rings are mainly composed of extremely minute particles, since almost every substance when reduced to fine powder appears much whiter than in larger masses. The singular bright spot which I saw on the eastern extremity of the outer ring during several hours on the evening of May 13, 1919, and subsequently mentioned at a meeting of the Society, was noticed by other observers on the same date. Its anomalous behaviour has not been satisfactorily explained. Despite his ill repute as the devourer of his children, Saturn maintains a family of nine satellites; the ninth having been named "Phoebe".

I have nothing of interest to mention relative to Uranus. As for Neptune, everyone is aware that owing to detection of a very slight perturbation effect whereby its actual position differs from the predicted place to the extent of 2″, the existence of a still more distant planet is considered certain; its position, mass, distance from the sun, and other elements having all been computed, and its opposition predicted as occurring about the end of December, though I have not learned that it was actually observed then, or since; which is not surprising in view of its faintness and the many small stars among which its orbit now lies.

Passing now in thought far beyond the narrow confines of the solar system, we come to the stars properly so called. The vast canopy of the starry heavens, which from the earliest times excited the wonder and admiration of the human race, though now less admired, often scarcely noticed, by the "finished and finite clods" who unfortunately constitute so large a proportion of the world's present population, is becoming more wonderful, more attractive, more mysterious even, to the astronomer, who as his knowledge grows and his means of investigation develop, still finds the problems with which he is confronted ever increasing in magnitude and complexity, but also in importance. Therefore he resolutely confronts the difficulties which hinder his work of investigation and research, with a settled determination to penetrate the secrets, unravel the mysteries, of the sidereal universe.

It would be impossible in several addresses such as this to give an adequate account of all the results arrived at through the investigations carried on during 1919 relative to the stars, the galaxy,

the nebulae and star clusters. Therefore I can only refer to a very few of them. In a general way I may say at the outset that our knowledge of stellar parallaxes has been very materially extended, thus vastly enlarging our conception of the distances of the stars; and to a certain extent the same holds good for a moderate number of nebulae, though naturally with a larger proportion of uncertainty. Besides what is known as the trigonometrical method, use was freely made of the spectroscopic method which I attempted to explain when addressing the Society a year ago, of the method based on absolute magnitudes, and other means more or less inferential. All the conclusions reached have tended to enlarge our comprehension of that portion of the universe accessible with our present means, and there comes also a conception of universes still vaster lying far beyond; for space does not appear to be dark, but glowing with a faint, yet definite, luminosity, which more than hints at the existence of other galaxies so distant that the light from their myriads of stars reaches us only as a dim, almost imperceptable, glimmer.

One of the questions debated among astronomers during a considerable period is, the true classification of the stars, and the arranging of these in what should be regarded as a rational evolutionay series. Clearly a star must have had a beginning at *some time*, no matter how remote, and the view long accepted, following Laplace, has been, that a star was formed through the gradual condensation of a nebulous structure by the action of gravity, and possibly other forces, though the process has never been seen in operation; but our period of observation is so brief compared with that required for the development of a star that lack of such an instance is but to be naturally expected. It being then assumed that the nebular hypothesis accounts for the formation of stars, these would naturally exist in different stages of development, dependent on the age, the mass, the chemical and physical condition of every individual body. Reasoning on these lines a classification was made, the brightest and whitest stars being assumed to be the hottest, the temperature being supposed to have declined through definite degrees in the yellowish-white, yellow, and orange stars, and to have fallen very considerably in the ruddy and red stars. But spectroscopic study, and investigation on other lines,

have demonstrated the necessity for a revision of that arrangement; it having become evident that *all* those termed "red stars" are not declining, but many actually rising, in temperature. In that way we now have the hypothesis of "giants" and "dwarfs" among the stars; the former, on the up-grade as it were, the latter, going down. This hypothesis, besides other merits, helps to obviate the acknowledged difficulty that, according to the earlier view, *all* stars must be regarded as on the decline.

An immense assistance to investigations such as the foregoing is afforded by that great and truly wonderful work, *The Draper Memorial Catalogue of Star Spectra*, an additional volume of which was bestowed on the scientific world in 1919. Over 200,000, star-spectra have already been photographed, measured, studied, classified, and recorded in this monumental catalogue, which is still in progress; and though it by no means supersedes the detailed spectroscopic study of individual stars, it vastly aids every department of astrophysical research, and also forms an invaluable record of the physical and chemical condition, at definite times, of each of the stars included within its range.

A vast amount of work and study has been devoted to the nebulae, regarding which many important, and frequently surprising, results have been arrived at, The definite connection of many of these extraordinary objects with the galaxy of stars seems not improbable, though many others are undoubtedly entirely separate and remote from it. The view that the spiral nebulae are located at much greater distances than those assigned to other classes, and that each spiral actually constitutes an individual galaxy, is being disputed, seemingly on good grounds. Various studies by different methods have led to the conclusion that at least a million spirals are within reach of the great reflecting telescope at Mount Wilson. Globular clusters are now regarded as at least as distant as the spiral nebulae, and therefore would seem to be star-universes of inconceivable vastness. Planetary nebulae may all have originated as novae or temporary stars. Some of those known to have had their origin, in that way, appear to be returning to a stellar condition. Our ideas as to the distance and actual dimensions of the galaxy itself are being greatly enlarged in view of evidence which is being accumulated by several investigators.

Since almost all the temporary stars, or Novae, so far recorded, have appeared in, or on the borders of, the galaxy, I will now say a few words relative to two of these objects. The Nova which blazed out in the constellation Aquila on June 8th, 1918, was visible as a small stellar body during the summer and autumn of 1919. When its emergence from daylight made observation possible it appeared to have changed little in brightness during the six months preceding, being about magnitude 6.5; but during the ensuing six months its light diminished gradually with slight evidences of fluctuation, till, at the end of November it was only a little above the 8th magnitude. It will in all likelihood have sunk to invisibility, except in large telescopes, by June next. Observers have differed considerably in their estimates of its magnitude since the object became faint. I am inclined to believe that two small stars preceding the Nova, distant from it about 9′ have also sensibly declined, which may indicate they have some sort of physical connection with it. The visual spectrum underwent a gradual change, the hydrogen and helium lines fading to invisibility, till practically all the light, except a faint continuous spectrum emitted by the nucleus, was that of nebulium. The rapid decline in brightness of the Nova, especially during its earlier stages, appears to me more difficult to explain rationally than its almost instantaneous outbursts. As to this latter, I think the most reasonable explanation of several suggested, is, that a rapidly moving stellar body encountered a resisting medium, probably a cosmic cloud, whereby its motion was retarded and as a consequence its superficial temperature enormously increased within a very short period. In attributing its decline to the effects of radiation and expansion only, the difficulty arises, that as we are evidently considering a stellar body of large size it must be apparent that such a mass of incandescent matter would not cool by these processes alone, with the rapidity the observed phenomena demand. Consequently a theory has suggested itself to me whereby radiation and expansion are supplemented by a process of disintegration or dissociation of elementary materials, the operation demanding, and rendering latent, as the expression is, an enormous amount of the energy existing in the forms of heat and electricity. A brief review of the spectroscopic phenomena exhibited by the star during its earlier stages is necessary to render my meaning intelligible. The

spectrum of the Nova immediately after its outburst was continuous with some absorption lines as in an ordinary star. Obviously this was the effect of a sudden and great exaltation of temperature, on a body possessing a considerable degree of density. Then some bright lines and bands gradually superposed themselves on the continuous spectrum, the hydrogen series first becoming conspicuous, along with fainter lines due to helium, and some other elements. But though those persisted, there soon developed, with steadily growing intensity, the characteristic spectrum lines (in this case they were broad bands) of nebulium, a gas sought for vainly among the elements known to chemists; but familiar to astronomers as the chief constituent of gaseous nebulae. Simultaneously with the appearance of nebulium, the Nova rapidly declined in brightness, and a decline in temperature also became evident, the continuous spectrum fading, particularly toward the violet. I believe this diminution of the light and heat to have been closely associated with a development of nebulium in enormous quantity; I therefore think we would be justified in assuming that this gas originated through the disintegration or dissociation of the ordinary elementary forms of matter, metals, or others, existing as such in the star up to the time when the cataclysmic event occasioned an inconceivable augmentation of temperature, accompanied by electric phenomena on a scale of which we can have no conception. The theory I offer assumes nebulium to be one of the primordial constituents from which the so-called chemical elements are built up, though its existence cannot be made evident by any means at our disposal, the forces at our command being inadequate to overcome the bonds by which primordial atoms are bound together into the metallic, or other form with which we have to do. The terrific cataclysm attendant on the retardation of a stellar motion would, and did, give rise to stupendous forces, among which we only know to a limited degree, heat and e ectricity, but energy would doubtless be developed in other forms with which we are unacquainted. And then the *mere shock* of such a collision would almost certainly have a disruptive effect capable of upsetting the atomic structure of matter as we know it. If bombardment by the particles discharged continuously from a minute quantity of radium be sufficient to disintegrate nitrogen, how much greater effect may we attribute to the bom-

bardment of a sun by cosmic dust in a cloud dense enough to retard, or even halt, its tremendous stellar velocity, thereby raising its temperature 100,000-fold in a period of a few hours? The vast supply of energy absorbed and rendered latent through the work accomplished on the atoms would disappear for the time being, but would not be lost, and must reappear as sensible heat if later, under more normal conditions the primordial elements should re-combine. This would result in a great elevation of temperature throughout the nebula. A high temperature for the nebulae is demanded by the hypothesis of Laplace though he assigned no cause for their acquiring a heated condition. Before leaving the subject I should mention that during 1919 Nova Aquilae expanded into a nebula having a measurable diamenter of about one second of arc.

In August last there was found on the Draper Memorial plates at Harvard Observatory a small star irregularly variable between magnitudes 7 and 9, and having a spectrum resembling that of η Carinae. It is located in the constellation Ophiuchus not far distant from Nova Auqilae 3. Information of this discovery reached us too late to admit of observations being made here. The existence of an analogy between Novae and such irregular variables as η Argus can hardly be doubted.

During 1919 astronomy suffered a great loss through the death of Prof. Edward Charles Pickering, director of Harvard Observatory. The invaluable work he accomplished during many years will always remain an enduring monument to one whose genius, energy, and devotion cannot be too highly extoled.

Death also removed Jerome Coggia, remembered chiefly as the discoverer of a periodic comet named after him.

J. A. Repsold, renowned as a maker of meridian circles of the highest accuracy, died at the age of 83 years.

The whole scientific world deplores the decease of Sir William Crooks whose great discoveries in chemistry and physics have also had an important bearing on astronomy.

I desire to mention with most respectful and sincere regret the decease of Madame Flammarion, the wife of M. Camille Flammarion the veteran astronomer and scientific writer, whose name is familiar as a household word to astronomers, professional or

amateur, the world over. I think no more eloquent tribute to a deceased wife was ever spoken than that uttered by her husband, when, referring to her, he said: "Sa mort est la première peine qu'elle me cause".

During 1919 our Society lost two old and valued members; George G. Pursey, and Angus Sinclair, M.A. The former, though not an astronomer in the strict sense, felt a genuine interest in the science, and was one of the small body of men whose steady devotion led to the establishment of this Society in its incorporate form. Mr. Sinclair did excellent service as the Society's librarian during several years. Both gentlemen were highly respected by all who knewthem.

I regret very much that during 1919 means could not be found for mounting in some permanent way so as to be available for the members' use, two excellent telescopes belonging to the Society. The difficulty has been to find a suitable location near our headquarters whereon a small observatory could be erected to house the instruments. I trust that during 1920 the Council will not overlook the great benefits which would accrue through carrying out this project.

The matter of popular ignorance relative to astronomy was brought forward for consideration at several meetings of the Council during 1919, a suggestion being made that the Minister of Education be asked to have astronomy added to the list of school studies. There is at present a strong tendency to diminish, rather than extend, the number of subjects to be studied by pupils in the public schools and the collegiate institutes. My own feeling is, that astronomy might well be put forward rather as a recreation than as a strict study, this being encouraged by the introduction of suitable books into the school libraries throughout the Province, to be read alike by teachers and pupils. By thus arousing interest in what is really a fascinating subject teachers and pupils would be induced to learn and to work together. They would soon be able to recognize the principal constellations and the larger planets, after which further knowledge would be gained very rapidly. An elementary acquaintance with optics would render easy the construction of a few simple instruments by means of which very interesting and instructive observations might be made. I feel satisfied such a plan would work out successfully, especially in the rural schools where pupils have relatively few amusements to occupy their leisure time in the evenings.

[*Continued from page 28*]

[FROM THE TRANSACTIONS OF THE NOVA SCOTIAN INSTITUTE OF NATURAL SCIENCE.]

THE FESTIVAL OF THE DEAD[1]

By R. G. Haliburton, F.S.A.

In European Calendars, the last day of October, and the first and second days of November, are designated as the festivals of All Halloween, All Saints, and All Souls.

Though they have hitherto never attracted any special attention, and have not been supposed to have been connected with each other, they originally constituted but one commemoration of three days' duration, known among almost all nations as "the Festival of the Dead," or the "Feast of Ancestors."

It is now, or was formerly, observed at or near the beginning of November by the Peruvians, the Hindoos, the Pacific Islanders, the people of the Tonga Islands, the Australians, the ancient Persians, the ancient Egyptians, and the northern nations of Europe,

[1] At the suggestion of the writer, the above paper was substituted for one read before the Institute, which had been privately printed. In the previous one, on "New Material for the History of Man, Derived from a Comparison of the Customs and Superstitions of Nations," it was endeavored to show that the source of these superstitions, so far from being "absolutely unattainable," as it has been hitherto considered by all who have treated of them, could be arrived at by a comparison of the customs of civilized and savage races; and that those superstitions, being possessed of a marvellous vitality, are valuable historical memorials of primitive society.

As an illustration of the duration and universality of primitive superstitions and customs, those connected with the habit of saying "God bless you!" to a person who sneezes, were selected. This absurd custom, referred to by Homer, and found in Europe, Asia, Africa, Polynesia and America, was traced to a belief found in the Arctic regions, Australia, and Central Africa (and it might have been added, in Ireland), that death and disease are not the result of natural, but of supernatural, causes; and that when a person sneezes, he is liable to be a victim of the spirits, or as the Celtic race express it, "to be carried off by the fairies." It was also argued that this custom, the trivial nature of which precludes the idea that it could have been borrowed by nations from each other, or that nature can everywhere have suggested it to the human race, plainly must have been inherited from a common source, and is a very conclusive argument in favor of the unity of origin of our race. These views have been confirmed by the observations of Captains Speke and Grant (see Illustrated London News, July 4, 1863, p. 23). An interesting little work by W. R. Wylde, on "Irish Popular Superstitions," published by William S. Orr & Co., London—which the writer was unable to procure until after the paper was read before the Nova Scotian Institute—supplies very curious facts, which corroborate his conclusions as to the origin of this custom. See from p. 120 to 135; also p. 51 to 58. See also Strada's Prolusiones—*Cur sternuentes salutentur* Lib. iii. Prael. iv.

and continued for three days among the Japanese, the Hindoos, the Australians, the ancient Romans, and the ancient Egyptians.

Halloween is known among the Highlanders by a name meaning the consolation of the spirits of the dead, and is with them, as with the Cinghalese,[2] the Pacific Islanders, and almost every race among whom the festival is observed, connected with a harvest home, or, south of the equator, with a first fruits celebration.[3] An old writer asks why do we suppose that the spirits of the dead are more abroad on Halloween than at any other time of the year[3] and so convinced are the Irish peasantry of the fact, that they discreetly prefer remaining at home on that ill-omened night. The Halloween torches of the Irish, the Halloween bonfires of the Scotch, the Coel Coeth fires of the Welsh, and the Tindle fires of Cornwall, lighted at Halloween, are clearly memorials of a custom found almost everywhere at the celebration of the festival of the dead. The origin of the lanthorn festival has never yet been conjectured. It will be found, I believe, to have originated in the wide-spread custom of lighting bonfires at this festival.

The church of De Sens, in France, was endowed by its founder in the days of Charlemagne, for the purpose of having mass said for the dead, and the graveyard visited on All Halloween.[4] Wherever the Roman Catholic Church exists, solemn mass for *all souls* is said on the second day of November; on that day the gay Parisians, exchanging the boulevard for the cemetery, lunch at the graves of their deceased relatives, and hold unconsciously their "feast of ancestors," on the very same day that savages in far distant quarters of the globe observe in a similar manner their festival of the dead.[5]

Even the Church of England, which rejects *All Souls*, as based on a belief in purgatory, and as being a creation of Popery, devoutly clings to All Saints, which is clearly a relic of primeval heathenism.

On All Souls day, the English peasant goes *a-souling*, begging for "a soul cake for all Christen souls." He has very little suspicion that he is preserving a heathen rite, the meaning of which is not to be found in the Book of Common Prayer, but (as I shall hereafter show) is to be discovered in the sacred books of India, in which country the consecrated cake is still offered, as it has been for thousands of years in the autumn, to the souls of

[2] See Brady's Clavis Calendaria, as to Oct. 31st.
[3] See Brand's Popular Antiquities, i. p. 388, 396. (Ed. 1853.)
[4] Hodie in Ecclesia Senonensi, sit Anniversarium solemne, et generale pro defunctis.—Thiers' Traité des Superstitions, iii. 98.
[5] Atlantic Monthly for May, 1862.

deceased ancestors.[6] But, though the festival of the dead is so generally observed in November, there are some exceptions. Thus it was observed in February by the Greeks, the Romans, the Persians, and the Algonquins of America, and in August by the Japanese and Chinese. The traces of its being observed in May are very few, and those of its being held at any other times of the year are of exceedingly rare occurrence. Before, therefore, I can attempt to treat of the festival of the dead, or refer to its origin and history, and the influence it has exerted on ancient mythology, it is necessary to confine this paper simply to questions connected with the calendar, and the times when the festival is found to be observed. It is important to trace the ancient November festival to the primeval year, which must have fixed it in that month among races south, as well as north of the equator. This year, I believe I have succeeded in discovering; and, as it appears to have originated in, or at least only now exists in, the southern hemisphere, I have designated it as the Primitive Southern year. It is also necessary to show that the festival of the dead, occurring in February or August, indicates a change having taken place, and a more recent year, commencing in February, having been substituted. As we only find this year north of the equator (so far as I have been able to learn), I have designated it as the Primitive Northern year.

Wherever the festival occurs in November, it is, or at least originally was, the new year's festival of the primitive southern year. Where it is held in February, it is, or once was, the commemoration of the commencement of the northern year.

As the mode of investigation pursued on this point materially adds to the credibility of my conclusions, I may be pardoned for referring to it.

The startling fact that "this feast was celebrated among the ancient Peruvians at the same period, and on the same day that Christians solemnize the commemoration of the dead (2d November),"[7] at once drew my attention to the question, *how was this uniformity in the time of observance preserved, not only in far distant quarters of the globe, but also through that vast lapse of time since the Peruvian, and the Indo-European first inherited this primeval festival from a common source?*

It was plain that this singular uniformity could never have been preserved by means of the defective solar year in vogue among ancient nations. How then could this result have been produced? It was apparent that the festival must have been regu-

[6] Maurice's Indian Antiquities, ii. 189.

[7] Peruvian Antiquities, by M. Rivero and Von Tschudi, translated by Dr. Hawks, New York, 1855, p. 134.

lated by some visible sign, or mark, that nature had supplied, such as the rising of some constellation.

Remembering the ancient traditions as to the Pleiades, I naturally turned my attention to them. Professor How kindly offered to ascertain from an excellent astronomer whether the Pleiades could have ever risen in November in Asia or Europe. I was fortunately, however, able to save that gentleman the calculation. On turning to Bailly's *Astronomie Indienne*,[8] I found him state that the most ancient year, as regulated by the calendar of the Brahmins of Tirvalore, began in November, and I was much gratified at finding that, in that calendar, the month of November is called Cartiguey, *i.e.*, the mouth of the Pleiades,—a circumstance which, M. Bailly says, would seem to indicate that that constellation by its rising or setting in that month, must have regulated the commencement of the ancient year in November.

But here a fresh difficulty arose as respects the calendar. To suppose that the Pleiades rose in that month, and commenced the year in the autumn, was not only opposed to ancient traditions respecting them, and to their name as the Stars of Spring (*Vergiliae*), but also to their actual movements, at the present day at least.

We could not assume that great astronomical changes could ever have produced this result. How then could we account for the anomaly? I discovered the clue in extending my researches to the southern hemisphere, where I found the festival of the dead to occur in November, and to be the vernal new year's festival of a year commencing in November, and regulated by the rising of the Pleiades *in the evening*.

Before concluding this prefatory paper, it may be as well to state that the whole subject, both as regards the primitive new year festival of the dead and the primitive year, has altogether escaped the observation of the learned. De Rougemont, in his *Peuple Primitif*, published at Paris in 1856, has, out of three volumes, not devoted as many pages to "Les Fêtes des Morts," though they are unquestionably the most remarkable memorials we possess of *Le peuple Primitif*. Festivals connected with the seasons, he says, cannot now be investigated, from our ignorance of the primitive calendar; and he therefore only selects those that took place at the time of the vernal equinox and the summer solstice, *i.e.*, associated with a solar year, and hence of a comparatively recent date, and subsequent to those of the two primitive calendars to which I have referred.

"Nous ne pouvons ici faire un étude spéciale de celles, qui se rapportent avant tout aux saisons; les calendriers des anciens nous

[8] Vol. I, p. 28, 134.

sont trop imparfaitment connus, pour que nous puissions espérer de reconstruire celui du peuple primitif."[9]

The primitive year of two seasons, commencing in November, and the connection of the Pleiades with the primeval calendar, are not even referred to in the latest work on the astronomy of the ancients, published last year in Paris.[10] Though very many remarkable facts in the history of the calendar and of our race, to which the study of the festival of the dead has afforded me a clue, are referred to by Greswell in his learned works on the Calendars of the Ancients, he has attempted to explain them by resorting to the miracles in the Bible—as to the sun having stood still or gone back on certain occasions—events which he contends must not only have disturbed, but have even left their impress on the calendars of the ancients. But they are, I believe, capable of a more common-place solution. I trust that I shall be able to prove that these subjects are susceptible of an explanation, without having, with Greswell, to refer to miracles in the days of Hezekiah, or with Ovid, to leave the knotty point to be unravelled by the Gods—

> "Dicta sit unde dies, quæ nominis extet origo
> Me fugit, ex aliquo est invenienda deo."[11]

The Festival of the Dead Brought to Europe and Asia by a Migration of Races from the Southern Hemisphere.

"Mudán de pays y de estrellas."[1]—Garcillasso de la Vega.

"Who can restrain the pleasant influences of the Pleiades?" we are asked in the book of Job, the most ancient production of sacred or profane literature. "The lights in the firmaments of the heavens," "for signs and for seasons, and for days, and for years," are supposed to have reference to that constellation, as well as to the sun and moon, for in early ages neither the sun nor the moon could have indicated the length of the year, or its division into seasons. The extreme veneration of remote antiquity for the Pleiades, or *Ver*giliæ, for having marked the seasons, and the beginning of the spring, are amongst the most venerable traditions of our race, and are now only realized among Australian savages,

[9] Vol. I, p. 523.

[10] "Antiquité des Races Humaines. Reconstitution de la Chronologie, et de l'Histoire des Peuples Primitifs. Par l'examen des documents originaux, et par l'Astronomie," by Rodier.

[11] Fasti, Lib. v.

[1] They change their country and their stars.

who still worship the Pleiades as announcing spring, "and as being very good to the blacks;" and at their culmination hold a great new year's corroboree in November, in honour of the *Mormodellick*, as they call that time-honoured constellation. The name given to these stars by the Romans, *Vergiliae*, is plainly connected with the strange tradition of Northern natives, of the Pleiades having marked the commencement of spring. They are popularly known, from France to India, by the same name—a circumstance which proves, says M. Bailly,[2] that our first knowledge of these stars was derived from the most ancient nations of Asia.

The question naturally suggests itself, Whence arose this veneration for a constellation, that among us, at least, is no longer reverenced? When and where can they have marked the beginning of spring, and what were those "pleasant influences," referred to in the book of Job, and still celebrated by Australian savages?

So far from rising in Europe or Asia in the spring, they first appear in June, a summer month. How could the *Ver*giliæ, then, have acquired their name, as the stars of spring? It is plain that they could not have marked a vernal commencement of the year, *as the most ancient year commenced in the autumn*, and among most ancient nations we find traces of a traditionary or civil year commencing in the autumn.

We also find traces of a very singular year of six months, the very existence of which Sir Cornewall Lewis has somewhat hastily questioned. "These abnormal years," he tells us, "are designated by Censorinus as involved in the darkness of remote antiquity."[3] Dupuis suggests that we must turn to the Pleiades, as well as to other constellations, to account for these "abnormal years," as well as for the ancient year commencing in the autumn,—"pour expliquer les fictions relatives à ce commencement d'année, soit chez les Juifs, soit chez les autres peuples, qui ont eu le commencement d'année en automne. Tels étaient ceux qui avaient des années de six mois."[4] In confirmation of this conjecture, I have found that in the Arabian calendar of lunar mansions, which is made up of two divisions, one belonging to summer, and the other to winter,—one of the mansions is designated by the name of the Pleiades. Let us see if his suggestion will prove equally correct respecting the autumnal year; and let us endeavour to find in that constellation a clue to the remarkable circumstance of the festival

[2] This name was the *Hen and Chickens*; among the Hindoos, Pillalou Codi; among the Jews, Succoth Benoth (?); among the Italians, Gallineta, and among the French, *La pousinière*. See Dupuis De l'origine de tous les Cultes, ix., 192. Bailly's *Astronomie Indienne*, I., xxxv. 134, 328. See, however Landseer's Sabæan Researches, Lecture XL., p. 19.

[3] Historical Survey of the Astronomy of the Ancients, p. 31.

[4] L'Origine de tous Les Cultes, i. p. 104.

of the dead having been observed in Hindostan, Peru, Ceylon, Egypt, and Europe, in November.

I may here state that the classical nations of antiquity, with whom the influence of the Pleiades was rather a matter of tradition than of practical use, when they spoke of the rising of the Pleiades, referred to the heliacal rising of the constellation in the morning, *i.e.*, the time, when at dawn, the stars were first visible—[5]

"The grey dawn and the Pleiades
Shedding sweet influence."

This took place in the middle of May, 2000 years ago, and marked the beginning of summer in the south of Europe and Asia.[6] But we must conclude either that the Pleiades must have once, in some other manner than by their heliacal rising, indicated the beginning of spring, or else that there must have been, by a long lapse of years, a change in their movements, that rendered their rising inconsistent with their very name as the stars of spring. It must, however, have been nearly 5000 years since the heliacal rising of the Pleiades occurred at the beginning of April, and even then it could not have indicated the commencement of seed-time in the south of Asia and of Europe, or marked the beginning of spring. Their name, the *Hesperides*, too, would seem to connect them with the evening rather than the morning. But if, at such a remote era, the Pleiades regulated the seasons by their heliacal rising at that time of the year, they must have left their impress on primitive calendars, and traces of the connection of the calendar with the heliacal rising of the Pleiades, would still be found among many races, either in their names for March or April, or at least in their traditions as to the time when their year once commenced. But this is not the case. There are no traces of a primitive year in general use in remote antiquity, commencing in March, April, or May; the only apparent exception being the solar year, regulated by the vernal equinox, which was of comparatively recent invention.

But on examining the calendars of ancient races, we find in Persia, India, Egypt, and Peru, that the month in which our first of November festival would fall, bears in its very name a singular impress of its former connection, either with the Pleiades or the festival of the dead.

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[5] Pleiades adspecies omnes, totumque sororum
Agmen; ubi ante Idus nox erit una super.
Tunc mihi non dubiis autoribus incipit aestas,
Et tepidi finem tempora veris habent.
Ovid Fasti, Lib. v.

[6] See as to the cosmical and heliacal risings of stars. Greswell's Fasti Catholici, iii. 13.

(*To be continued*)

In the most ancient calendar in India, the year commenced in the month of November, which bears the name Cartiguey, *i.e.*, the Pleiades; a constellation which, Bailly suggests, must by its rising or setting at that time, once have regulated the primitive year. We find also that, in the month of October the Hindoos, like ourselves, have three days which are connected with the festival of the dead.

In the ancient Egyptian calendar the same resemblance can be traced between the name of the Pleiades, which among the Hebrews and Chaldeans is Athor-aye, with that of the Egyptian month of November, which is Athor. The Arab name for the Pleiades, Atauria, also suggests a resemblance.

In November took place the primeval festival of the dead, clad in a veil of Egyptian mythology. The Isia, the solemn mourning for the god Osiris, "the Lord of Tombs," lasted for *three* days, and began at sunset, like the Lemuria of the Romans, and the festival of the dead among the Persians and other nations.

The singular custom of counting the day from the sunset of the preceding day, or the noctidiurnal system, was so universal, that Greswell refers to it as a conclusive proof of the unity of origin of our race.[1] The Bible tells us "the evening and the morning were the first day." Our words "fortnight" and "se'nnight," are traces of this primitive custom. But the first day of our festival of the dead, is a still stronger illustration, as it is called Hallow*eve*. The origin of this custom has not been explained by Greswell. Volmer connects it with the word Athor, which means "the night;" and which he therefore supposes represented the first evening of creation. But the most important night, not only in that month, but in the whole Egyptian year, was that of the 17th of Athyr, when the three days of mourning for Osiris (*i.e.*, the festival of the dead) began with an *All Halloweve*. Hence the origin of this widespread noctidiurnal system is to be found in whatever caused the festival of the dead to commence at sunset, or with a Hallow*een*.

Let us turn to the primitive races of the southern hemisphere to find a solution:—

1*st*, For the festival of the dead being connected with an agricultural celebration. 2*d*, For its being held in November. 3*d*, For its commencing with a Halloweve. 4*th*, For the primitive year commencing in November. 5*th*, For the Pleiades being connected with that month. 6*th*, For their being reverenced as the *Ver*giliæ and Hesperides, the stars of the spring and the evening. 7*th*, For the "abnormal year" of six months, found north of the equator. A reference to the Australians and Pacific Islanders

[1] See Volmer's Wörterbuch der Mythologie, verb. Athor, p. 371.

will enable us to give a very simple explanation for these various points, without imagining that miracles must have given rise to some, or that we must leave the solution of others to the Gods.

We find that, among these southern races,[8] when the Pleiades are in the evening first visible at the horizon, which is at the beginning of November, they mark the beginning of the year, and the vernal new year's festival, a feast consecrated to first fruits, and to the dead. As long as at evening they continue visible, they mark a season called *the Pleiades above*. When they cease to be visible in the evening, the second season commences of *the Pleiades below*: these seasons nearly equally dividing the year. Hence we can understand why tradition has connected the Pleiades with November, as the first month of the year, has preserved their name as the stars of the evening and of the spring, and has caused the festival of the dead to commence in the evening, or with a Halloween. We can also understand how the year of six months arose, that has so puzzled astronomers.

In the voluminous report on the Aborigines, by a Committee of the Legislative Council of Victoria, Session 1858-9, we find W. Hull, Esquire, J.P., a gentleman who has written a work on the Aborigines, stating "their grand corroborees are held only in the spring, when the Pleiades are generally most distinct; and their corroboree is a worship of the Pleiades as a constellation, which *announces spring*. Their monthly corroboree is in honour of the moon" (p. 9).

In another place Mr. Hull says, "Referring again to their worship of the stars, I may mention that one night I showed Robert Cunningham the Pleiades, and he said 'they were the children of the moon, and very good to the black fellows.'—a remark that recalls to our mind 'the pleasant influences of the Pleiades.'"

C. J. Tyers, Esq., Commissioner of Crown Lands, Alberton (p. 79), says in confirmation of the foregoing,—"Regarding their religious practices very little is known, so little that Europeans generally believe them to be devoid of any. Yet they do, according to their manner, worship the hosts of heaven, and believe particular constellations rule natural causes. For such they have names; and *sing and dance to gain the favour of the Pleiades* (Mormodellick), the constellation worshipped by one body as the giver of rain." Now the Pleiades are most distinct at the beginning of the spring month of November, when they appear at the horizon

[8] I have only been able to fix the date of this festival among the Peruvians, the Australians, and the natives of the Society and Tonga Islands. The difficulty of procuring necessary works of reference in a Colony will plead, I trust, an excuse for many omissions.

in the evening, and are visible all night. Hence their vernal festival of the Pleiades takes place in honour of the Vergiliæ, the stars of spring, at the beginning of November, the very month called in the calendar of the Brahmins of Tirvalore, the month of the Pleiades, and among the ancient Egyptians connected with the name of that constellation.

But we are told by another gentleman examined by the committee, that all the corroborees of the natives are connected with a worship of the dead,[9] and *last three days*. If this be the case, is it not somewhat startling to find that Australian savages, at or near the time of Halloween, All Saints, and All Souls, also consecrate three days to the memory of the dead, as a vernal new year's celebration, regulated by the time-honoured Pleiades,—and, like the northern festival of the dead, beginning in the evening, or with a Halloween?

"Hinc ubi protulerit formosa ter Hesperus ora,
Ter dederint Phoebo sidera victa locum;
Ritus erit veteris nocturna Lemuria sacri;
Inferias tacitis Manibus illa dabunt." [10]

In the Tonga Islands, which belong to the Feejee group, the festival of Inachi, a vernal first fruits celebration, and also a commemoration of the dead, takes place towards the end of October,[11] and commences at sunset.

"The Society Islanders," Ellis tells us, "divided the year into two seasons of the Pleiades or Matarii. The first they called the *Matarii i nia,* or the *Pleiades above*. It commenced when, in the evening these stars appeared at or near the horizon" (*i.e.*, at or near the beginning of November), and the half-year during which, immediately after sunset, they were seen above the horizon, was called *Matarii i nia*. The other seasons commenced when at sunset these stars are invisible, and continued until at that hour they appeared again above the horizon. This season was called *Matarii i raro, i.e.*, "the Pleiades below." The Pleiades are visible at the horizon in the evenings at the beginning of November. They then culminate near midnight, and are visible till morning. Ellis says that this year began in May; but it is evident that what he calls the first season, "the Pleiades above," commenced at or near the

[9] In confirmation of this, a member of the N. S. Institute, who has been at these annual corroborees, tells me, that as the natives for these occasions paint a white stripe over their arms, legs and ribs, they appear, as they dance by their fires at night, like so many skeletons rejoicing. The custom, however, is peculiar, I believe, to Australia. *White* paint is used for mournful, and *red* for joyful, festivals. See Report on Aborigines, p. 70, 94.

[10] Ovid's Fasti, Lib. v.

[11] Mariner's Tonga Islands, p. 157, 381, 385.

beginning of November, and the second division must have begun towards the end of April, or early in May. If they appear at the horizon in the evening, on the 5th November, they continue visible at that time till the 24th April following. But, not only was the month of November connected with the rising of the Pleiades, but also with a festival of the dead, and a first fruits celebration, as among the people of the Tonga Islands.

"The most singular of their stated festivals was the ripening or completing of the year. Vast numbers of both sexes attended it; the women, however, were not allowed to enter the sacred enclosure. A sumptuous banquet was then held. The ceremony was viewed as a *national acknowledgment to the gods.* When the prayers were finished, and the banquet ended, a usage prevailed *resembling much the Popish custom of mass for souls in purgatory.* Each one returned to his home or family marae, there to offer special prayers for the spirits of departed relatives." Ellis does not tell us to what mode of dividing the year he refers (for they appear to have had three); but, as the feast of Alo Alo in the Tonga Islands, as well as the festival of the Pleiades in Australia, took place in November, we may assume that this was the new year's festival of the season of the Pleiades.[12]

Let us turn from the Islands of the Pacific to Peru, and there we find the primitive calendar of two seasons marked by a new year's festival of the dead, occurring in November, and celebrated at precisely the same time as in Europe and Polynesia.

The month in which it occurs, says Rivero,[13] "is called Ayamarca, from *Aya,* a corpse, and *marca,* carrying in arms, because they celebrated the solemn festival of the dead, with tears, lugubrious songs, and plaintive music; and it was customary to visit the tombs of relations, and to leave in them food and drink. *It is worthy of remark that the feast was celebrated among the ancient Peruvians at the same period, and on the same day, that Christians solemnize the commemoration of the dead* (2d November)."

Finding the festival held at the beginning of November, I felt convinced that it never could have been fixed in that month by a solar year, such as was in use in Peru, but that it must have been originally the new year's festival of the year or seasons of the Pleiades, that must have once been in use in that country. Subsequent investigations bore out the conclusion.

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[12] It was held at the time of "the blossoming of the reeds." As the winter season lasts from July to October, this festival must have occurred in October or November. See Ellis, Polynesian Res. I., 86, 351.

[13] Rivero's Peruvian Antiquities, transl. by Dr. Hawks (New York 1855), p. 134.

(*To be continued*)

MEETINGS OF THE SOCIETY

ANNUAL MEETING.

The Annual General Meeting of the Society was held in the Physics Building of the University of Toronto, at 8 p.m., January 13, 1920, the President, Mr. A. F. Miller, in the chair.

On motion, the minutes of the last annual general meeting, having been printed in the JOURNAL, were taken as read and approved.

Miss Budd and Mr. Macdonald were appointed scrutineers to count the ballots cast for officers to be elected at the present meeting.

Mr. W. F. W. Jackson, the General Secretary, presented and read his Report for 1919, including reports received from the Victoria and Montreal centres, and on motion by Mr. Jackson, seconded by Professor Chant, it was received and adopted.

Mr. H. W. Barker, the General Treasurer, presented and read his Report for 1919, and the financial reports from the Victoria, Ottawa and Montreal centres, and on motion by Mr. Barker, seconded by Mr. J. R. Collins, the reports were received and adopted.

Prof. Chant, the Librarian, presented and read his Report for 1919, and on motion by Prof. Chant, seconded by A. F. Hunter, the report was received and adopted.

On motion by A. F. Hunter, seconded by Dr. Satterly, it was resolved that the thanks of the Society be tendered to the President, the General Secretary, the General Treasurer and the Librarian for their services during the year.

The scrutineers reported that seventy-six ballots had been cast, and the officers elected for 1920 were as follows:

Honorary President—Otto Klotz, LL.D., D.Sc., F.R.A.S.
President—Mr. J. R. Collins.
First Vice-President—W. E. W. Jackson, M.A.
Second Vice-President—Wm. Bruce, J.P.
General Secretary—A. F. Hunter, M.A.
General Treasurer—Mr. H. W. Barker.
Recorder—Mr. Joseph A. Pearce.
Librarian—Prof. C. A. Chant.
Curator—Mr. Robert S. Duncan.

Council—Sir Joseph Pope, K.C.M.G.; Rev. D. B. Marsh, D.Sc.; John Satterly, M.A., D.Sc.; Dr. W. M. Wunder; Samuel Beatty, M.A., Ph.D.; and Mr. Stuart Strathy.

The scrutineers also reported that the proposed amendments to the Constitution had been approved by more than two-thirds of the votes cast, thus complying with Article VIII of the Constitution. The amendments were as follows:

To insert the word 'General' before 'Secretary' and also before 'Treasurer' in Article IV, third line.

To substitute the word 'ten' for the word 'six' in Article V, first line, and in Article VI, first line, thus increasing the number of Councillors to ten.

The Chairman declared the above officers elected as the Officers for 1920, and the amendments to the Constitution as passed.

On the request of Mr. A. F. Miller, the retiring President, Mr. J. R. Collins. the President-elect, took the chair. He thanked the members for the honour they had conferred upon him, referring in complimentary terms to the work of Mr. Miller during his presidency of two years, and expressing regret that Mr. Miller had decided not to accept the presidency for a longer term.

On motion, Dr. J. B. Fraser and Mr. A. R. Hassard were appointed the auditors for 1920.

On motion, the President and the General Secretary were named a committee to make arrangements for the annual "At Home" on January 27th.

A. F. HUNTER, *Recorder for 1919.*

REPORT OF THE GENERAL SECRETARY.

I have much pleasure in presenting the report of the Secretary for the year 1919. Greatly increased interest in astronomy has been manifest throughout the year. The attendance at the regular meetings is much improved and reference to matters astronomical is of almost daily occurrence in the newspapers. The membership of the Society is increasing as the following table shows:

MEMBERS.

Centre.	1918	1919
Toronto	153	170
Guelph	20	19
Ottawa	68	75
Hamilton	14	11
Victoria	68	48
Regina	11	11
Peterborough	6	7
Winnipeg	18	20
Montreal	37	40
	395	401

During the year the Society lost by death two very old members, Mr. Angus Sinclair and Mr. George G. Pursey, as well as one honorary member, Professor E. C. Pickering, which we record with much regret.

Seventeen meetings were held during the year in the University Physics Building and I think all will agree the accommodation is much superior to that of our former meeting place.

Reports have been received to date from only the Montreal and Victoria centres. They are as appended.

Respectfully submitted,
W. E. W. JACKSON, *General Secretary.*

Mr. K. M. Chadwick, Secretary of the Victoria Centre, reports as follows:

The last Annual meeting was held on December 18, 1918. Owing, unfortunately, to the ban on public meetings and to the ill health of one of the lecturers, the Society has been unable to hold its full number of meetings; the following lectures were recorded in the minute book:

1918—Dec. 18—Performance and Work of the New Telescope, by Dr. Plaskett.
1919—Jan. 28—A lecture arranged for this date was postponed by the Executive, owing to the prevalence of influenza.
Mar. 11—The Structure of the Universe, by Dr. Young.
April 2—Earthquakes and How Recorded, by N. Dennison.
Nov. 25—Items of General Interest in France, by G. G. Aitken, M.C. and Bar.

On May 6 a visit was paid to the Dominion Observatory, by the kind invitation of Dr. Plaskett, whose pleasing address and description of the telescope was much appreciated by the members and their friends.

Executive Meetings were held at 1122 Government Street on December 30, 1918, March 14, October 17 and December 1, 1919.

Memberships—There are 44 members on the roll and subscriptions have been paid as follows: 1 life member (Dr. R. K. Young); 1 member paid for 1921; 2 members paid for 1920; 26 members paid for 1919; 8 members paid for 1918; 2 members paid for 1917.

Rev. W. T. B. Crombie, Secretary of the Montreal Centre, reports as follows:

The interest has been steadily maintained throughout the year. Number of members upon the Roll 40, an increase of 5 during the year. Four meetings were held. They were as follows: On March 13 the Society had the pleasure of listening to the Rev. Dr. Marsh, F.R.A.S., who lectured on "The phenomena of the Solar Surface". On June 12 Mr. H. E. S. Asbury gave a most able address on the subject of "Comets, their history, movements, etc". Almost every phase of the subject was dealt with—comets in literature ancient and modern; comets in art as well as in science; descriptions of various famous comets, their orbits, etc. On September 11 Mr. George Sample spoke on "the Law of Gravitation" and on December 11 Rev. W. T. B. Crombie, M.A., took as his subject "Modern Selesnography and Selenology", and illustrated his remarks by numerous slides showing with remarkable clearness the nature of the lunar surface.

The officers of last year were re-elected: President, Mgr. C. P. Choquette; Vice-President, Mr. H. E. S. Asbury Sec.-Treasurer, Rev. W. T. B. Crombie,

M.A.; Council, George Sample, James Weir, B.Sc., Lt.-Col. W. E. Lyman, B.A., John Conway and Miss M. Ellicott, in place of Lt.-Col. R. Wilson deceased.

Reports from the centres at Ottawa and Winnipeg were received too late for the Annual Meeting, but they are added herewith.

Mr. R. M. Motherwell, Secretary for Ottawa, reports as follows:

During the past year eleven meetings of the Society were held, five afternoon meetings and six evening meetings. The evening meetings were held as usual in the Carnegie Library and the large attendance was very gratifying. The executive decided at the beginning of the year that the lectures should be of a more popular nature than in previous years and the wisdom of their policy is shown in the increased attendance. The afternoon meetings were of a technical character as usual and were held in the Geodetic Survey Building. As the Department of the Interior has placed a ban on these afternoon meetings it will be necessary to hold more evening meetings and it would be wise for the Society to consider the policy of holding series of lectures on very elementary astronomical subjects.

The following lectures were held in the afternoons: The Alaska Boundary Survey, its Difficulties and Compensating Pleasures, by J. D. Craig, D.L.S.; Sunlight Engineering, by H. L. Seymour, D.L.S.; Changes in the Map of the Heavens, by R. M. Motherwell, M.A.; Adjustment of Primary Triangulation, by D. J. Fraser, B.A.; The Canadian Engineer in the War, by G. H. McCallum, B.Sc.

The following meetings were held in the evenings: Astronomy as a Recreation and Adjunct to Everyday Life, by C. A. Bigger, D.L.S.; The Benefits of Science, by Dr. A. B. Macallum; The Planet Saturn, by Sir Joseph Pope; The Moon and its Functions as the Earth's Satellite, by Dr. W. Bell Dawson. Results from the Recent Total Eclipse of the Sun, by Dr. S. A. Mitchell; The Myths of the Constellations, by Prof. D. Buchanan.

During the year there have been eight new members elected besides a large number of proposed members to be elected at the next regular meeting of the Society.

Prof. O. T. Anderson, the secretary for Winnipeg, reports as follows:

Six regular meetings have been held during the year:

1919—Jan. 19—Correction Lines, by Geo. H. Herriot.
Feb. 12—The Total Solar Eclipse of 1918, by Dr. H. R. Kingston.
March 12—Astronomical Calendar of The Ancients, by Mrs. Howey.
March 26—Progress in Astronomy, by Dr. L. A. H. Warren.
April 4—With the Yerkes Observation Party, by Dr. Warren.
Nov. 15—The Moon, by Mr. C. E. Bastin.

The following is a list of officers elected: Honorary President, Mr. Frank Powell; President, Prof. L. A. H. Warren, Ph.D., F.R.A.S.; Vice-President, Mr. J. H. Kolb; Sect.-Treasurer, Prof. H. R. Kingston, M.A., Ph.D.; Council, Mrs. W. E. Howey, Mr. H. B. Allan, Mr. C. E. Bastin, B.A.; Mr. H. E. Riter, B.A.; Prof. N. B. MacLean, M.A., F.R.A.S.C., D.S.O.

An effort is being made to arouse more interest in the Centre and it is hoped to increase the membership to not less than fifty before the spring.

GENERAL TREASURER'S REPORT.

FINANCIAL STATEMENT FOR YEAR ENDING DECEMBER 31, 1919.

RECEIPTS.

Ca h in Bank, December 31, 1918	$647.33
Grant from Dominion Government	2,000.00
Grant from Province of Ontario	600.00
Grant from City of Toronto	100.00
Grant from University Governors	100.00
Fees from Members	709.38
Refund post office order (Harvard Annals)	6.95
Payment from University on Dr. Bauer's expenses	25.00
Interest on Bonds and Bank Account	111.58
Canada Permanent Bond redeemed	872.40
	$5,172.64

DISBURSEMENTS.

Publication of JOURNAL and HANDBOOK and other printing accounts	$2,023.05
Public Meetings	169.25
Library ((Books, etc.)	88.21
Stationery, Stamps and Exchange	101.24
Rent (Balance for 1918)	100.00
Rent of office to December 31, 1919	120.00
Salaries (Office Secy. and Caretaker)	372.00
Grant to Montreal Centre	150.00
Grant to Ottawa Centre	150.00
Grant to Victoria Centre	75.00
Grant to Winnipeg Centre	50.00
Grant to Guelph Centre	25.00
Victory Bond purchased	1,000.00
Balance in bank	748.89
	$5,172.64

NOTE—During the year a Canada Permanent Mortgage Corporation Debenture for $872.40 bearing 5% interest has been redeemed and replaced by a Dominion of Canada Victory Loan Bond of $1,000 bearing 5½%. Another Canada Permanent 5% debenture for $500 has been renewed at 5½ %. The Society also holds a Canada Permanent Debenture (not yet due) for $500, yielding 4½%.

Respectfully submitted,

H. W. BARKER,
General Treasurer.

Appended are financial reports from the Centres at Ottawa, Victoria, Winnipeg and Montreal.

OTTAWA CENTRE.

Receipts.

Balance on hand	$17.61
Cheque from the General Treasurer	150.00
	$167.61

Expenditures.

Lectures	$70.00
Printing	45.35
Advertising	21.72
Postage, Exchange, etc	6.40
Caretaker's Expenses	6.00
	$149.47
Balance on hand	18.14
	167.61

Examined and found correct,
(Sgd.) D. Robertson.

Respectfully submitted,
D. B. Nugent,
Local Treasurer.

December 19, 1919.

VICTORIA CENTRE.

Treasurer's Statement.

1918, December 18, Annual Meeting, Balance in Bank		$118.27	
Members Dues forwarded to Toronto		102.00	
			$16.27
Receipts.			
1918, December 31, Bank B.N.A. interest		$1.72	
1919, June 30, Bank B.N.A. interest		1.14	
			$2.86
March 24, Grant from Parent Society			75.00
Dues—1 Life Member		$25.00	
1 Member paid for 1921		2.00	
2 " " " 1920		4.00	
26 " " " 1919		52.00	
8 " " " 1918		16.00	
2 " " " 1917		4.00	
			103.00
			$197.13

EXPENDITURES.

January 20, Miss Holmes, typewriting	$1.50	
June 23, Colonist Account to date	22.95	
July 9, Huxtable Lantern Slides	7.20	
August 26, Times Account to date	6.10	
November 12, Secretary Stamps, etc.	2.00	
December 4, School Board, use of room	6.00	
December 12, Fleming Lantern Slides	10.85	
	$56.60	
December 16, Balance in Bank	140.53	
	$197.13	
		$197.13

OUTSTANDING LIABILITIES.

Dues for 1918 for Toronto	$2.00	
Dues for 1919 for Toronto	103.00	
		$105.00
The Colonist Printing Co.		5.85
The Times Printing Co.		6.35
		$117.20

I have audited the Treasurer's Statement as above set forth and in my opinion such Statement is properly drawn and exhibits a correct view of the state of the Society's affairs up to present date, viz., December 16, 1919. (Signed)

T. R. SHOTBOLT, *Auditor.*
K. M. CHADWICK, *Sec.-Treas.*

MONTREAL CENTRE.

FINANCIAL STATEMENT DECEMBER 18, 1918, TO DECEMBER 11, 1919.

RECEIPTS.

Balance Cash on Hand	$6.42
Grant from General Treasurer	150.00
Members Fees	45.50
Commission on Cheque	.15
Total Receipts	$202.07

EXPENDITURES.

Cash sent General Treasurer	$45.00
Expenses of Lecturer	28.15
Expenses of Local Secretary as ordered by Council	32.20
Advertisement	9.00
Janitor's expenses	4.50
Lantern Attendant	4.00
Postage and Stationery	6.14
Other expenses	3.00
Total Expenditures	$131.99
Balance Cash on hand	$70.08

Respectfully submitted,
W. T. B. CROMBIE,
Secretary-Treasurer.

LIBRARIAN'S REPORT

During the year the Library continued to receive its numerous exchanges as follows:

From Canada and the Empire	43
From the United States	53
From other countries	27

It was possible, also, to secure the early volumes of the Harvard *Annals* and thus complete the set. Those acquired were formerly the property of L. Trouvelot, well known for his drawings of celestial objects, and were obtained from Paris. Individual volumes purchased were 26; and presented 4. The number of periodicals received, 615.

The accommodation for the Library is very inadequate but nothing better is at present in sight. When the proposed new observatory becomes a reality the Library will have a suitable home.

C. A. CHANT,
Librarian.

NOTES FROM THE METEOROLOGICAL SERVICE

Summary Report of the Weather in Canada.

December, 1919.

Temperature.—The temperature was below the average throughout the Dominion, and in nearly all localities to a very marked extent, making one of the coldest Decembers on record over the greater portion of the country. Some of the chief negative departures were 10° at Kamloops, 9° at Edmonton, and 12° at White River.

Precipitation.—The precipitation over the Dominion was, as a rule, comparatively light, positive departures from normal being recorded only in a few widely scattered localities in British Columbia and the Western Provinces, and in districts contiguous to the Georgian Bay. Over the greater portion of the Western Provinces the amount was less than one inch, and in Southern Ontario and the Province of Quebec it ranged between one and two inches.

TEMPERATURE FOR DECEMBER 1919.

STATIONS	December		STATIONS	December	
	Highest	Lowest		Highest	Lowest
Yukon			*Western Provinces—cont.*		
Dawson	12	−54	Qu'Appelle	42	−53
British Columbia			Regina	39	−33
Atlin	39	−20	Saskatoon	40	−31
Agassiz	54	8	Souris	37	−30
Barkerville	39	−26	Swift Current	44	−32
Kamloops	57	−21	Winnipeg	38	−28
New Westminster	55	10	*Ontario*		
Prince Rupert	53	10	Agincourt	47	10
Vancouver	53	11	Aurora	43	−17
Victoria	52	16	Bancroft	39	−24
Western Provinces			Barrie	43	−21
Battleford	50	−36	Beatrice	40	−30
Calgary	56	−32	Bloomfield	47	−11
Edmonton	55	−32	Brantford	49	− 3
Medicine Hat	53	−36	Chapleau	—	—
Minnedosa	38	−30	Chatham		1
Moosejaw	46	−28	Clinton	47	− 8
Oakbank	42	−33	Collingwood	43	−10
Portage la Prairie	—	—	Cottam	40	− 3
Prince Albert	46	34−	Georgetown	40	−12

TEMPERATURE FOR DECEMBER 1919—*continued*

STATIONS	DECEMBER		STATIONS	DECEMBER	
	Highest	Lowest		Highest	Lowest
Ontario—continued			*Ontario—continued*		
Goderich	—	—	Southampton	44	− 8
Gravenhurst	40	−30	Stonecliffe	42	−28
Grimsby	49	− 4	Stoney Creek	51	− 3
Guelph	40	− 8	Toronto	49	− 7
Haliburton	40	−27	Uxbridge	44	−20
Huntsville	37	−27	Wallaceburg	42	—
Kenora	28	−40	Welland	52	− 9
Kinmount	—	—	White River	33	−51
Kingston	46	−10	*Quebec*		
Kitchener	39	− 8	Brome	54	2
London	47	− 5	Father Point	38	−22
Lucknow	42	−11	Montreal	46	−14
Markdale	37	−12	Quebec	39	−27
North Gower	48	−20	Sherbrooke	46	−18
Oshawa	—	—	*Maritime Provinces*		
Ottawa	44	−14	Charlottetown	44	−10
Paris	47	− 5	Chatham	39	−26
Parry Sound	38	−26	Dalhousie	—	—
Peterborough	44	−16	Fredericton	41	−26
Port Arthur	41	−28	Halifax	50	−10
Port Burwell	45	− 1	Moncton	47	−20
Port Dover	40	− 5	St. John	46	−17
Port Stanley	44	− 5	Sussex	48	−20
Queensborough	45	−21	Sydney	50	− 4
Ronville	41	−27	Yarmouth	50	0

EARTHQUAKE RECORDS BY MILNE SEISMOGRAPH, TORONTO.

P.T. = Preliminary Tremors. S. = Secondary Waves. L. = Large Waves. A.C. = Air Currents. Time is Greenwich Mean Civil Time; it is to be given in hours, minutes and decimals of minutes; 0 or 24 h = midnight.

SIR FREDERIC STUPART, F.R.S.C., DIRECTOR.

No.	Date 1919	P.T. Comm.	S. Comm.	L.W. Comm.	Max.	End	Max. Amp.	Remarks
		h m	h m	h m	h m	h m	mm.	
	Dec. 3			Marked micros when other station records quake.				
2072	" 5	..	..	0 47.7	..	..	..	Phases masked by micros.
2073	" 12	..	..	4 32.3 4 34.0	..	..	0.1	Small micros going on
2074	" 14	..	..	0 58.9	..	1 04.3	0.2	
2075	" 14	..	..	1 37.6	..	..	0.1	
2076	" 14	..	..	2 13.5 2 15.7	2 17.4	2 35.8	0.3	Earthquakes reported from Alaska on the 14th
2077	" 14	..	..	3 23.0 3 26.5	..	..	0.1	
2078	" 15	..	..	20 18.5	..	20 22.5	0.05	
2079	" 17	..	..	0 21.7	..	Micros.	0.05	
2080	" 20	21?03.5 21?05.7	.21?16.1	21 29.8 21 41.0	21 44.1	Micros.	0.5	9280km. marked micros render measurements doubtful
2081	" 21	..	..	18?48.9	..	..	0.2	Micros going on
2082	" 23	..	..	0 22.6 0 26.8	..	..	0.1	Small micros going on
2083	" 26	..	..	17 16.2 17 19.6	17 22.3	..	0.2	Thickening, light turned down at 17 h. 37 m.

Period of Boom 18 seconds. Pillar inclination 1 mm = 0″.45

VICTORIA, B.C.

F. NAPIER DENISON, SUPERINTENDENT.

No.	Date 1919	P.T. Comm.	S. Comm.	L.W. Comm.	Max.	End	Max. Amp.	Remarks
		h m s	h m s	h m s	h m s	h m s	mm.	
2064	Dec. 3	2 26 26	..	2 26 55	2 27 25	2 30 21	0. 1	215 km. off Pt. Estevan. Felt there and at Alert Bay Wireless Station
2065	" 5	0 32 28	0 37 03	0 41 29	0 43 56	0 55 44	0. 2	2760 km.
2066	" 12	4?22 16	..	..	4 26 42	4 35 03	0. 2	
2067	" 14	1 32 02	1 39 24	..	2 00 04	2 29 05	0. 2	
2068	" 14	..	..	..	3 34 29	..	0. 05	
2069	" 15	20?16 59	..	..	20 18 57	20 25 50	0. 2	
2070	" 18	0?12 21	..	..	0 20 13	0 25 08	0. 05	
2071	" 18	1 34 58	..	1 38 54	1 41 21	1 49 43	0. 3	
2072	" 20	21 00 50	21 06 18	21 15 43	21 29 36	22 43 28	0. 5	3670km. Marked micros from 20 h. 29 m. to 20 h. 44 m.
2073	" 21	..	..	..	18 55 28	..	0. 05	May not be seismic
2074	" 23	0 23 38	..	..	0 32 59	0 41 20	0. 1	
2075	" 26	16 56 58	..	..	17 01 24	17 09 51	0. 1	
		Perio	d of Boo	m 18 sec	onds. P	illar incli	nation 1	mm =0″.54
				V	ertical Se	ismograp	h	
	" 3	2 24 55	..	2 25 35	2 25 45	2 31 30	μ6	300 km. off Estevan Point

NUMBER OF SEISMIC DISTURBANCES RECORDED AT TORONTO FROM 1899 TO 1919 INCLUSIVE, AND FOR THE COMPLETE PERIOD OF 21 YEARS.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1899	6	4	6	6	2	9	23	13	31	13	18	9	140
1900	21	5	10	3	3	11	7	9	5	12	8	8	102
1901	8	8	7	8	7	2	3	6	4	6	10	16	85
1902	13	7	9	5	0	2	3	6	5	5	4	4	63
1903	7	9	3	6	2	5	5	5	4	4	4	4	58
1904	3	3	7	4	6	8	3	5	8	2	4	3	56
1905	4	5	8	8	4	5	8	0	4	5	7	10	68
1906	15	17	11	12	1	12	5	8	6	4	3	9	103
1907	5	2	4	9	9	6	2	7	2	4	5	3	58
1908	2	7	4	3	3	1	3	6	4	4	8	3	48
1909	5	4	2	8	9	3	5	5	1	7	4	3	56
1910	6	10	4	5	8	14	4	3	13	8	12	9	96
1911	5	9	3	6	7	8	7	5	7	13	10	10	90
1912	8	2	2	5	8	67	10	7	7	6	11	14	147
1913	8	4	10	9	6	6	13	9	5	14	5	4	93
1914	5	9	15	7	9	6	9	11	6	16	12	7	112
1915	15	4	6	9	19	16	4	8	13	8	7	9	118
1916	13	11	11	14	7	12	3	15	11	13	12	8	130
1917	6	9	6	6	18	20	20	8	3	9	12	13	130
1918	9	15	11	8	10	15	13	9	11	17	12	16	146
1919	8	5	10	12	21	8	16	10	12	8	10	12	132
Total	172	149	149	153	159	236	166	155	162	178	178	174	2031

Of the total in June 1912, there were recorded: 6 on the 5th; 6 on the 6th; 17 on the 7th; 14 on the 8th; 9 on the 9th; 6 on the 10th. Total 58. These may not all be different quakes, some may be the aftershocks. They were centred in Alaska.

NUMBER OF SEISMIC DISTURBANCES WITH AMPLITUDE OF 5mm. AND OVER RECORDED AT TORONTO IN EACH YEAR FROM 1899 TO 1919 INCLUSIVE.

Year	5mm. to 10mm.	10mm. to 15mm.	15mm. to 25mm.	25mm. and over	Total
1899	4	2	..	3	9
1900	3	..	2	1	6
1901	4	..	..	..	4
1902	4	..	1	1	6
1903	1	..	1	..	2
1904	2	1	1	..	4
1905	1	1	1	..	3
1906	..	..	4	1	5
1907	2	1	2	..	5
1908	2	..	..	..	2
1909	1	..	..	..	1
1910	1	..	2	..	3
1911	3	1	1	..	5
1912	7	..	1	..	8
1913	1	..	..	..	1
1914	1	..	..	..	1
1915	2	2	..	2	6
1916	4	2	..	1	7
1917	3	2	1	3	9
1918	3	3	..	1	7
1919	4	..	..	1	5
Total	53	15	17	14	99

NUMBER OF SEISMIC DISTURBANCES WITH AMPLITUDE OF 5 mm. AND OVER RECORDED AT TORONTO FROM 1899 TO 1919 INCLUSIVE, SHOWING THE MONTHS IN WHICH THEY OCCURRED.

Month	5mm. to 10mm.	10mm. to 15mm.	15mm. to 25mm.	25mm. and over
January	9	..	5	2
February	2	..	..	1
March	2	..	1	..
April	2	3	2	3
May	8	1	..	1
June	5	4	2	1
July	5	1	2	..
August	3	1	2	..
September	1	1	1	3
October	3	..	2	3
November	6	1	..	..
December	7	3	..	..

J. YOUNG.

MAGNETIC DISTURBANCES.

NOVEMBER—DECEMBER 1919.

The continuous records of the Magnetic Forces obtained at Agincourt and Meanook Observatories indicate greatly reduced activity in the Earth's Magnetic Field during November and December. No pronounced disturbance was recorded at Agincourt in November and only one in December on the 15th. At Meanook

two moderate disturbances were recorded in November on the 4th, and 22nd, and one in December on the 14th and 15th. The subjoined table gives the principal data of these disturbances.

MAGNETIC DISTURBANCES

75th M.T.		Range			
Beginning	Ending	Agincourt H	Agincourt Z	Agincourt D	Meanook D
h m	h m	γ	γ	′	′
November 3, 23 30	November 4, 18 —	117	44	38.9	88.5
November 21, 22 30	November 22, 23 —	110	45	33.8	88.1
December 14, 23 20	December 15, 21 —	422	384	87.1	231.3

THE THEORY OF GRAVITATION

Dealing with Newton's views and their subsequent history, Professor Sampson said it was only familiarity that prevented us from noticing the unexplained wonders on all sides of us, Newton's expressed views on the nature of gravitation were marked on the one side by a defensive guard against those who charged him with bringing back into philosophy an occuly property inherent in matter, which expressed itself in the formal shape given to his great work, the "Principia" where nothing was admitted beyond what was exactly demonstrated from observation; and, on the other side, by great fertility of suggestion and theory in letters, showing how he regarded gravity as somehow transmitted by an atomic ether prevading all space.

The question of its nature was inseparably involved in the conception of space, time and matter, and before it could be advanced Newton's theories of these, required fundimental scrutiny. But for upwards of a century attention was engrossed in working out the consequences of Newton's law of gravitation, treated merely as a formula, without preoccupation as to its foundations. The way for its discussion was paved by various studies of the foundations of geometry, for example, by Helmholtz. These made it clear how arbitrary were most of our ideas of the science, and how, for example, we may be quite unconscious of changes in our standards of length. Such studies contributed to a state of mind prepared to adopt a radical revision of the ideas of mechanics, but actual advance came from electrical and physical experiments.

J. J. Thomson's discovery of the electron, and that it was endowed with mass, and that this mass was only an expression of its electro magnetic energy, and depended upon its velocity, pointed out that Newton's conception of mass as inert quantity of matter was inadequate. But the cardinal experiment, only slowly appreciated at its full significance, was Michelson and Morley's proof that we were utterly unable to detect in any phenomena the motion of the earth through the ether, rapid as this was. In the hands of Larmor, Lortntz and of Einstein in his earlier work this was shown to involve a reconstruction of our whole frame of motion and mechanics, even of time. It was known as the theory of relativity, because its postulate was that we were unable in any way to perceive absolute motion. The theories however, invented in each case *ad hoc*, were to some degree partial and incoherent.

The time had come to clear them all away, and to replace them by one comprehensive calculation, which should start from the beginning.—Prof. R. A. Sampson in *English Mechanic and World of Science*, Dec. 19, 1919.

NOTES AND QUERIES

Communications are Invited, Especially from Amateurs. The Editor will try to Secure Answers to Queries

Query

Where can the books mentioned in the preface to the Handbook for 1920 be obtained?—*Montreal Member.*

Answer

Young's *Uranography* and Upton's *Star Atlas* are both published by Ginn & Co., 70 Fifth Avenue, New York; while McKready's *Beginner's Star Book* is published by G. P. Putnam's Sons, New York. The prices before the war were 30 cents, $2 and $2.75, respectively. The publishers will supply them, but probably in most cases it will be found simpler to ask a local bookseller to procure them. It may be added that there are many other books of this type, some of them very excellent, but those issued in Europe are usually not so well adapted to lower latitudes. Further information will be gladly furnished.

Recollections of R. G. Haliburton

The publication in the last number of the Journal of the first instalment of Haliburton's "Festival of the Dead" brought a very interesting letter from Dr. Herman S. Davis, of Pittsburgh, Pa. Dr. Davis was a member of the United States Scientific Expedition of 1889-90, and while at St. Helena he met Haliburton. He gives the following extracts from his private journal:

Sat. March 1, 189c. On Board the *U.S.S. Pensacola*, in Jamestown Harbor, Island of St. Helena. . . . One of the visitors this afternoon was a certain Mr. Haliburton who is here for a year for his health. I was in the cabin on his arrival but was sent for to meet him "because he is an old man, acquainted with many astronomers and has spent much of his time in the study of ancient calendars and wishes to meet you because you have invented a perpetual calendar". Such was the message given me by the Captain's orderly. I went to see him, of course, and before we had talked a minute, he asked me earnestly if I would go to his home on the island to spend several days with him as he is living here all alone some miles in the interior. I declined to go to-morrow as I wish to get my letters

written ready for the leaving of the whaler to-morrow, but promised I would go on a later day. He remarked that I looked very young and that he had probably published his researches on the calendar several years before I was born and that he would send me a copy of his book to look over.

Mon. March 3. . . . On returning from shore to-day, I found awaiting me the book which Mr. Haliburton promised he would send to me. It bears a long title though it is a small book,—being in fact only a bound copy of several pamphlets. The title page says, in part: "New Materials for the History of Man, derived from a Comparison of the Calendars and Festivals of Nations, by R. G. Haliburton, F.S.A. No. I, The Festival of the Dead (here a quotation), Halifax, Nova Scotia, 1863. Printed Privately. This is followed by another pamphlet called, Part II, Astronomical Features in the Mosaic Cosmogony, Halifax 1864.

Number I, was originally a paper read before the Nova Scotian Institute of Natural Science and printed in the *Transactions* of that Society. The copy before me is a reprint preceded by a Preface and an Introduction and followed by Addenda, a Conclusion, Additional Facts and a Note. Part II is shorter and consists of a Preface and a chapter entitled "The Great Year of Mosaic Chronology". The book ends with the title pages of a German book: "Die Plejaden und der Thierkreis oder: Das Geheimniss der Symbole, von Ernst von Bunsen: Berlin 1879" and has the following dedication, "Widmung Herrn R. G. Haliburton von Neu-Schottland Dem ersten Begrunder der Symbolik und Zeitrechnung der Plejaden". The volume is sprinkled with autograph notes in great profusion,—"after-thoughts" of the author. On the fly leaves are extracts and notices of places where mention has been made of this book or its contents. Among these are Lubbock's "Origin of Civilization"; Tylor's "Primitive Culture", "Life and Work at the Great Pyramid"; Goodsir's "Ethnic Inspiration"; page 207 of "Quarterly Journal of Science for 1871"; "Our Inheritance in the Great Pyramid" and Lockyer's "Star Gazing; Past and Present". There are also extracts from a letter from M. de Bunsen of Karlsruhe.

The most noticeable feature of his arguments is in his chapter headed: "The Festival of the Dead brought to Europe and Asia by a Migration of Races from the Southern Hemisphere". I am perhaps more interested in this argument because of having read some years ago a book by Dr. Warren, noted educationalist and brother of Bishop Warren of our Methodist Church (himself no mean writer on astronomical subjects), entitled "Paradise Found, "wherein are many plausible arguments and a vast array of evidence to support his theory that the garden of Eden, or the birthplace of the human race, was at or very near the North Pole, which gave a good central point from which man could radiate south ward into Europe, Asia and North America when driven farther and farther by the change from a tropical temperature to what is now a frigid temperature. Here is the antithesis of that theory and though I have not had time to read this book with critical care, yet this cursory reading makes me think it only "a cunningly devised fable" like the Lost Atlantis, the Scriptiural Sgnification of the Great Pyramid and similar so-called scientific theories regarding unknowable mythical or pre-historical periods. . . .

As of Sat. March 8. . . . I went directly from Napoleon's Tomb to the summit of Halley's Mount, where I saw the place that Halley had his instruments mounted and the supposed place of Maskelyne's observations: the former in 1676 when twenty years of age and the latter in 1761 when but nine years older. I then abandoned beaten paths and went down and down, past flax fields and through coffee plats, over paths treacherous because steep and narrow and overgrown with grass on which my smooth shoesoles slipped and slipped and seemed ever inclined to play me false,

"And sought the vale with thickest foliage spread
On whose calm breast the mountain shadow falls"

and wherein nestled the home of Mr. Haliburton just east of Rosemary Hall, which a few days ago became the home of the exiled Zulu chiefs, Dinizulu, Undabuko and Tshingana, with their attendants.

I found Mr. Haliburton an interesting talker and he spent a long time talking about his literary work and unfolding to me his plans for an early visit to the United States where he wishes to continue his researches and prepare a more elaborate book. He impresses me as a gentleman of refinement and leisure, perhaps is wealthy, is rather aged and a bachelor. He spoke as if intimately acquainted with some of England's and Scotland's best astronomers and was altogether a very pleasant man to meet, except that he is very deaf. I am sorry I could not stay several days with him as he earnestly entreated me to do. As he is expecting not to remain much longer in St. Helena, he gave me as his permanent address: R. G. Haliburton, Care of Sir A. L. Haliburton, K.C.B., 57 Lowndes Sq., London, S.W.

He impresses me as somewhat eccentric and as if age is telling upon the vigor of his intellect. He remarked that he was planning to buy a villa not far from the one he was occupying and keep it solely as a "health resort for his American friends" and he invited me to come and stay as long as I please whether he is here or not. I told him that I was compiling information for a Biographical Cyclopedia of Astronomers and asked if he would supply me with data pertaining to himself as an author of books on allied topics, and he promises that he will. He also agrees to be my guest during a part of his sojourn in the United States next fall and wishes me to help him in the work he has outlined.

Continuing his letter Dr. Davis says:

On March 10, 1890, we left St. Helena and went to the Island of Ascension, where, on April 5, I received a letter from Mr. Haliburton from which I make these extracts. The letter is dated March 26, 1890.

"Dear Mr. Davis:

. . . . As to a biographical sketch of myself: I shall try to send you something, but I fear it will not interest you or the world much; I have done so little. . . . I fear I cannot see you before middle of August or beginning of September, but I may be able to turn up earlier. . . . Yours very sincerely,

R. G. HALIBURTON.

As I now transcribe the above pages from my private journal, I have this autograph letter before me. But attached to it is a newspaper clipping from the *New York Evening Post* of March 7, 1901, in which is stated that on that day had died Robert Grant Haliburton, K.C., of Halifax, second son of the late Hon. Justice Haliburton ("Sam Slick"). His death occurred at Pass Christian, Missouri.

It will be noted that in the volume described by Dr. Davis there was added to the chief paper, Part II.—"Astronomical Features in the Mosaic Cosmogony". This was not included in all the copies of the publication. In the copy in the Congressional Library at Washington the appended paper was entitled, "The unity of the human race proved by the universality of certain superstitions connected with sneezing", which is stated to have been read before the Nova Scotian Institute of Natural Science, May 4, 1863. The present writer would be glad to learn where the volume shown by Haliburton to Dr. Davis is, and also to obtain access to Part II, on the Mosaic Cosmogony.

The State of the Society

An examination of the report of the Annual General Meeting, which is published in this issue, shows that the Society is in a healthy condition. The number of members is slightly greater than that for the previous year; and I learn that very substantial increases in the membership at Winnipeg and Ottawa have been made after the reports for 1919 were prepared.

There are one or two features of the reports, however, which are not so satisfactory. Several of the Centres appear to have held no meetings during the year. These should be awakened to new life and activity. Then it appears that at some Centres the expenses for the meetings were actually greater than the receipts from fees, and the General Council of the Society was asked to bear the expenses of the Centre. While it is reasonable to expect special assistance from the Council in exceptional conditions, the Centres should meet all their ordinary local expenses and in addition contribute to the funds of the Society. The great increase in the cost of printing and engraving has rendered it difficult to issue the Journal and Handbook in the manner desired. If more funds were available for the purpose much other interesting matter

could be included and many more plates could be added. The fees of five hundred new members could well be added to the allowance for publication purposes.

I would suggest that the Governments of the different provinces as well as the Councils of the cities where the meetings are held be requested to give grants for local expenses. The Province of Ontario and the City of Toronto contribute in this way. In recognition of this assistance special public lectures and outdoor meetings are given for the citizens. In this way both the Society and the city benefit. I commend this to the consideration of the various Centres.

A Bright Meteor.

On March 2, at 10.42 p.m., while on St. George Street, Toronto, the present writer observed an exceptionally fine meteor. It was seen pretty accurately in the north-west direction and descended almost vertically, tending perhaps to the right-hand (to one facing the meteor). The colour was a vivid bluish green with a tinge of red in the trail. It was judged that it was 40 or 50 miles distant and it was hoped that news would come in of its reaching the earth in the neighbourhood of Orangeville, but nothing has been reported.

C. A. C.

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